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by: Paul Feinberg

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CONTENTS

Page

Introduction 1

General 1

VIP Components 2

Detailed Description 2

Types of Sampling 4

Frame Generation 6

VIP User Interface Requirements 8

Major Frame Pulse 9

User Sampling Rates 10

Conclusion 10

Acknowledgments 11

Appendix A: VIP Command List Description

THE NIMBUS D VERSATILE INFORMATION PROCESSOR (VIP) SATELLITE SYSTEM

by: Paul Feinberg

Introduction

Satellite telemetry systems in the past have been tailored to a particular mission or a predetermined set of experimental requirements. A unique telemetry system concept has been developed and will be implemented on the Nimbus D satellite which will provide a great degree of flexibility in the sampling and formatting of experimental or housekeeping data - the flexibility being achieved without design or wiring changes. This new system is called the Versatile Information Processor (VIP).

General

The Nimbus D VIP (Figure 1) will time multiplex, digitize (if required), and format data from seven different experiment systems and from all Nimbus D housekeeping sources. Spacecraft Time Code will also be processed by the VIP. The following Nimbus D experiments will use VIP to process their data:

Cloud Top Spectrometer
Ultraviolet Spectrometer (MUSE)
Infrared Spectrometer (SIRS)
Sferics
Selective Chopper Radiometer
Backscatter UV
Filter Wedge Spectrometer

Individual sampling rates for these experiments will vary from 5 samples/sec to 80 samples/sec; satellite housekeeping will normally be sampled at 1 sample/second or 1 sample/16 second.

The above experiment and housekeeping inputs will be accepted in either analog or digital form and will be formatted with synchronization, identification and other status words into one of several frame sequences.

Sampling rates and sequences will be generated through the use of a memory, control logic, and a simple command or instruction repertoire. To generate a sampling sequence, memory locations will be used in a computer like manner such that when the contents of the memory locations are decoded, a series of control pulses will be produced for any given input channel while will result in the desired sampling rate for that channel. Other memory locations, when decoded, will generate the necessary synchronization and identification words.

The memory will be sectioned with each section of memory used to generate a different program or commutation sequence. The contents of one of these memory sections will be reprogrammable from the ground, thus providing a remote programming capability in changing sampling rates or sequences before or after launch. A maximum of four different programs can be generated for operational, launch or any other special sampling sequence.

The Nimbus D VIP data will be formatted into a 4000 bit per second (400 word per second) serial bit stream to be recorded in bi-phase (split phase) on one of five tracks of the Nimbus D High Data Rate Storage System (HDRSS-D) tape recorder. The HDRSS-D will permit the recording, storage and transmission of data from several spacecraft systems - the VIP being one such system. Data will be collected and stored over an entire orbit on the five track tape recorder, and upon ground interrogation, played back at 32 times the record speed. All five tracks are played back simultaneously through a frequency division multipler whose output frequency modulates a S-band transmitter.

In addition to being stored on HDRSS-D, the 4000 bit per second formatted VIP data will be transmitted in real time over the 136.5 megacycle beacon transmission link.

VIP Components

The VIP spacecraft subsystem can be divided into four (4) main sections: the memory sequencer, the formatting unit, the reprogramming unit and the beacon transmitter unit. The memory sequencer including the memory and memory sequence controller circuitry will output bit patterns which, when decoded by the formatting unit, will generate the required sampling sequence.

The formatting unit will decode the memory sequencer bit patterns into the required sampling sequence. The formatting unit will contain analog and digital gating, a gate selection matrix, an analog-to-digital converter and the necessary control, timing and formatting logic.

The reprogramming unit will load the reprogrammable section of the memory from a serial bit stream supplied by the Nimbus D Command Clock Subsystem. After each loading of the reprogrammable section of the memory, ground verification will take place.

The beacon transmitter unit will provide a real-time transmission of either the VIP 4000 bit per second output bit stream, or the Command Clock Time Code output bit stream/Command Clock Memory unload bit stream.

Detailed Description

By the unique use of a 512 word memory and control circuitry, the VIP is able to time division multiplex data in a flexible and efficient

manner. 376 words of the 512 word (10 bits/word) memory comprise a non-destructive, read only portion of the memory which can be programmed or loaded with special ground equipment through a hardwired connection before launch. 128 memory words will be in a non-destructive readout (NDRO) portion of the memory. This portion can be altered at any time - on the ground or after launch - by remote means through the Nimbus D Command Clock. 8 words of memory will be used to provide a "scratch pad" memory function. The purpose of this memory portion is to provide the necessary counters to generate required sub-commutation sequences.

To generate any program or sampling sequence, the memory can be thought of as being composed of up to 4 independent sections, each capable of generating a particular program. In order to switch to a specified memory section, a ground command through the Command Clock is required.

The contents of most memory words consist of 10 bit internal commands or instructions. There are 8 different VIP commands which permit the efficient generation of an almost unlimited variety of formatted sequences. Command words are used:

a. To generate sampling of arbitrary points one or more times in each minor frame.

b. To generate subcommuted sampling of arbitrary points.

c. To generate synchronization, identification and other special words.

d. To "jump" to the beginning of the program being executed or to the start of the major frame sequence of another program.

The 10 bit binary words of some commands are used as addresses to open particular gates to be sampled. Attached to each VIP gate - there will be approximately 1000 of them - can be an analog or digital input from a spacecraft system. The VIP will decode the above type commands and produce control pulses which will allow sampling of the input at the required time and rate. The full decoding of these 10 bit commands results in 2^{10} unique combinations, i.e. all numbers from 0 to 1023, and consequently any of the VIP 1000 input can be sampled by specifying its assigned VIP gate number. For example, the decoding of the particular 10 bit word 0001000001 would produce a pulse which would allow the sampling of the input connected to VIP gate number 65.

The decoding of a memory word will be accomplished with a matrix which for efficiency of design has tentatively been sectioned as follows:

a. VIP gate addresses 0 through 15 will be used to sample digital "A" (serial digital) inputs.

b. VIP gate addresses 32 through 63 will be used to sample digital "B" (single-bit digital) inputs.

c. VIP gate addresses 64 through 639 will be used to sample analog inputs.

Detail of the 8 VIP internal commands and of how these commands can be used to generate the 80 by 80 word sample format sequence of Figure 2 and 2A are described in Appendix A. It is noted that less than 114 words in memory are used to generate 6400 (80 x 80) word sequence.

Basically in the VIP system a portion of words in memory will be sequencially cycled through each minor frame of a particular program. At the end of a minor frame, a minor frame counter will be incremented by one and the same portion of words in memory will be cycled through again in a manner required to generate the second minor frame of the program. The minor frame counter will continue to increment and therefore produce additional minor frames until the minor frame counter reaches a pre-determined limit or final value (i.e. 80 minor frames in the case of the Figure 2 sample format) which signifies the end of a major frame of data.

After cycling through the limit value minor frame, the minor frame counter is automatically reset to its initial or starting value. Without interruption the VIP continues throughout the orbit to generate minor and major frames for the selected program. The major frame interval is that period of time in which every input to be sequenced for a particular program has been sampled at least one time. Minor frames are sub-intervals of the major frame; each minor frame will begin with frame synchronization information.

Types of Sampling

The most efficient type of sampling generated by the VIP is commutated sampling of inputs or generation of synchronization words one or more times per minor frame. Regardless of the major frame length commutated channels required only 1 command word in memory for each time it is required to sample the channel during the minor frame. For example, in Figure 2, the SIRS(D) experiment is sampled 2 times each 0.2 sec minor frame to a depth of 80 minor frames. Only 2 command words in memory are required for this generation.

Sub-commutated sampling of inputs, i.e. multiplexing at submultiples of the minor frame rate, requires a different generation technique. If a minor frame word position is to be sub-commutated, it requires the use of memory words which are used as counters. These counters will allow the generation of either sequential or arbitrary subcommutation. Sequential subcommutation is the sampling of inputs connected to consecutive VIP gate addresses (i.e. ....5,6,7,8,9,....); arbitrary subcommutation is the sampling of inputs connected to random VIP gate addresses (i.e.....11,2, 14,81,10,....).

Sequential counters instead of arbitrary counters will be used in the great majority of cases to develop subcommutation because it takes only 3 words in memory to implement a sequential counter. These 3 words permit the counting from a starting gate address for a particular sequence to a final gate address. In Figure 2A for example, one counter is used to develop the sequential sub-commutation for minor frame word positions 16, 21, and 27. This one counter allows sub-commutation to a depth of 5 for each of the 3 minor frame word positions. Since any one counter can count from 0 to 1023, a particular counter can be used to produce sub-commutated sequences for many minor frame words which require the same depth of sub-commutation.

To generate an arbitrary sub-commutation sequence such as used for minor frame word position 61 in Figure 2A, you must still use 3 words in memory to develop a counter. However, the values of this counter are not decoded and used to directly address or open a VIP gate, but instead the counter values are used to select (indirectly address) other memory locations which are in turn decoded and used as in sequential sub-commutation. For each arbitrary sub-commutation sequence generated, 3 words in memory are required for the counter and 1 additional word in memory is required for each VIP gate of the sub-commutated, 8 words of memory would be required; whereas if these same 5 inputs were sequentially sub-commutated 3 words in memory would be required.

Arbitrary sub-commutation, although not as efficient to generate as sequential sub-commutation, is necessary to provide flexibility in the allocation or changing of the sequencing of an individual input or group of inputs once that input or group of inputs has been connected to the VIP. For example, if a particular input were wired to VIP gate number 107 and another input were wired to VIP gate 261 and if it were required to sub-commutate these 2 inputs, then arbitrary sub-commutation would be used since sequential sub-commutation could only sub-commutate inputs by incrementing by one (i.e. 107, 108, 109 etc.). Arbitrary sub-commutation can also be used to generate sub-commutation sequences where requirements exist for the multiplexing of the different types of inputs - analog, digital "A" and digital "B" - in the same sub-commutation sequence.

Frame Generation

The VIP output bit rate of 4000 bits/sec (10 bits/output word) limits the total possible VIP sampling rate for Nimbus D to 400 samples/sec. It is noted that the Nimbus D VIP output is constrained to 400 bits/sec due to the packing density limitation of the HDRSS-D tape recorder. The VIP itself is capable of up to 12000 bit/sec output rates.

To layout and generate a Nimbus D VIP major and minor frame format, such as shown in Figure 2 and 2A, there are various factors which must be considered:

1. Memory Efficiency

The VIP Command List, detailed in Appendix A, must be used with ingenuity so that the 376 words of the non-destructive read only portion of memory are adequate for all "fixed" mission programs and the 128 words of the NDRO portion of memory are adequate for the "reprogrammable" mission programs.

Utilizing sequential instead of arbitrary sub-commutation is an example of one means of more efficiently using the VIP memory. When using sequential sub-commutation, however, the consecutive addresses generated by the sequential counter constrains the mixing of analog and digital signals in the same sequence. This points out how that in some instances using the memory efficiently effects the type of sequences which the VIP can generate and therefore total system tradeoffs must be considered in any frame generation.

2. Sampling Capacity

The total Nimbus D VIP sampling capacity for experimental and housekeeping sampling, as well as for synchronization and identification generation, is 400 samples/sec. Individual sampling requirements must be sub-multiples of this total and must be able to be structured into the desired total frame. For example, if a new experiment which required sampling at 4 samples/sec, were to be formatted into the Figure 2 frame, it would be more efficient for the VIP to sample this experiment 5 samples/sec. The sampling at 5 samples/sec amounts to sampling once in each minor frame and takes only 1 word in memory to generate. To sample the experiment at exactly 4 samples/sec would require the use of a counter and would therefore be less efficient to generate. In this case we have used an extra sample/sec for the experiment. Thus, although the required minimum sampling rate for an experiment may be specified, a higher sampling rate may actually be utilized by the VIP to efficiently structure the sampling in the total format.

3. Gating Capacity

The Nimbus D VIP will provide for the sampling of approximately 1000 distinct input signals as follows:

A. 576 ± 68 analog inputs
B. 16 digital "A" inputs (serial digital)
C. 320 ± 30 digital "B" inputs (single bit digital)

4. VIP System Parameters

The following are specific VIP parameters which will affect frame generation:

A. The VIP will be capable of accepting four commands from the Nimbus Command Clock which will be used to select one of four programs stored in the memory. Four words in the memory will contain the starting addresses of the four stored programs.

B. The VIP will be capable of generating eight different subcommutated sequences, each of arbitrary length and starting point. These sequences are generated by counters, one of which will be used to generate a minor frame count. Each sequence will be capable of occurring one or more times during each minor frame with a maximum length of subcommutation determined by a 10 bit limit value.

C. The VIP will produce major and minor frame formats which are synchronized to the Minitrack Binary Time Code generated by the Nimbus D Clock Subsystem. Major frames will occur at 1 per second or multiples of 1 per second; minor frames will occur at 0.1 second or multiples thereof. A maximum of 256 minor frames will comprise any generated major frame sequence.

D. One, two or three 10-bit words in each minor frame will be used for frame synchronization. The digital coding and frequency of occurrance of frame sync will be specified by the memory sequencer program.

E. One 10-bit word in each minor frame will be used to identify the program (mode) and the minor frame being generated. The first two bits of this word will specify which one of four VIP programs is being generated. The final eight bits of this word will specify the number of the minor frame being generated.

F. The Command Clock Subsystem will generate a Binary Coded Decimal (BCD) Time Code occurring serially at 100 bits per second. The frame rate of one-per-second used four bit binary coded decimals for seconds, tens

of seconds, minutes, tens of minutes, hours, tens of hours, days, tens of days, hundreds of days and station ID. "Zeros" and sync bits are interlaced between the above data bits to produce the 100 bits per second Time Code rate. Every 0.2 second the VIP formatting unit will insert into the minor frame output format generation, at a time specified by the memory sequencer, a 10-bit word consisting of two consecutive 4 bit Binary Time Code samples (e.g., seconds and tens of seconds, etc.) with each sample preceeded by its Time Code word sync bit.

VIP User Interface Requirements

Users with experimental or housekeeping inputs to the VIP must conform to the following interface requirements:

1. Analog inputs

Analog inputs to the VIP shall range from 0 volts to -6.375 volts. Digitization of analog data will be accomplished with a conversion accuracy of 1 part in 256 (8 bits) or 25 mv.

Experiment or telemetry output impedance shall be 10K or less to maintain one precent accuracy. However, with prior approval, higher output impedance is permissible when capacitor-terminated outputs are provided.

The input impedance presented to each analog input signal will be 1 megohm during sampling time and 10 megohms during non sampling or turnoff time.

Leakage current to any analog input shall be maximum of 1 μa during sampling time and 50 na during non-sampling time. Under fault conditions the analog inputs to the VIP shall not exceed -25 volts or +0.8 volts.

2. Digital "A" Inputs

The VIP digital "A" input gating shall enable the transfer of a maximum of 10 bits of digital data per sample from an external source or experiment to the VIP. Figure 3 shows the digital "A" control signal characteristics and source interface requirements when using this input. B_1 and C_1 are timing signals common to all digital "A" users. A_1 is a control signal from the VIP that is provided to each particular digital "A" user. Each user's information shall be accepted during his "A_1" pulse select interval. The user's first (most significant) bit of information to be transferred shall be established; i.e., reached 90% of value, a minimum of 90 μs before the leading (positive going) edge of the first "C_1" shift pulse signal. The most significant bit shall remain at its level at least until the leading edge of the first "C_1" shift pulse signal

occurs. The second through tenth most significant bits shall be established by the falling (negative going) edges of the first 9 "C_1" shift pulses. The time delay from the 10% point on the falling edge of the shift pulse signal to the point at which the transition, if any, of the information output signal is 90% complete shall be less than 20 μs. These bits must remain at their levels at least until the leading edge of the next "C_1" shift pulse. A +5 ±0.8 volt signal shall be established with the tenth "C_1" shift pulse and shall remain for a minimum of 100 μs.

When being sampled, the user's information output signal ("D_1") shall be 0 ±0.8 volts for a logical "0" and +5 ±0.8 volts for a logical "1" with rise and fall times of less than 1 μs. During all times the experiment is not being sampled, i.e., when the "A_1" pulse is at 0 ±0.8 volts, the user's information output signal shall be 0 ±0.8 volts.

With the experiment power ON or OFF, the user's "D_1" signal output impedance shall be 600 ohms or less. Under fault conditions the digital "A" inputs to the VIP shall not exceed -1 or +8 volts.

3. Digital "B" inputs

The digital "B" input gating shall provide for the multiplexing of single-bit digital data (such as relay ON/OFF levels) into the VIP output bit stream. Control signals shall not be provided sources which utilize the digital "B" gating.

Sources which use the digital "B" gating shall have a telemetry output of 5 volts minimum to 10 maximum for the ON condition and 0 volts minimum to 1.0 volts maximum for the OFF condition. The source impedance in the ON condition shall be 1 megohm or less; in the OFF condition 50K ohms or less. Under fault conditions the digital "B" inputs to the VIP shall not exceed 25 or +0.8 volts.

Major Frame Pulse

To enable experimenters to phase their systems to the start of a VIP sampling sequence, the VIP will make available a major frame pulse 250 μs in length, whose negative going edge is coincident with the start of each major frame. Characteristics of the major frame pulse are as follows:

Amplitude: -5 ±0.8 volts and 0 ±0.8 volts
Output Impedance: 1000 ohms or less
Rise and Fall Time: Less than 1 μs

User Sampling Rates

The VIP will offer the user two types of sampling for each of his inputs. The first will be at the user's specified normal rate required to exact meaningful data. The second will be at a higher rate than normal which would be required for failure or malfunction analysis or which would be required for special purposes during the satellite lifetime.

The Nimbus D sampling requirements will be generated by one operational frame or program such as shown in Figure 2. As soon as all experimenters' requirements are specified, a final version of this operational program will be defined. This operational program presently offers housekeeping sampling at either one of two rates: 1 sample/sec or 1 sample/16 sec. Other housekeeping rates can also be made available.

The reprogrammable feature of the VIP will allow special sampling programs to be generated which could be used for trouble shooting or failure analysis either during ground test and integration or during flight operation. In this reprogrammable mode of operation any one or any group of experiment or housekeeping inputs could be sampled at much higher rates than would normally be required. In fact, by sampling only one input in this mode, the input could be sampled up to 380 samples/sec.

Conclusion

The VIP will offer Nimbus D users a centralized data processing system whose sampling capacity can be distributed with a maximum amount of flexibility. This flexibility can be used in many ways, some of which are as follows:

1. Normal testing and evaluation during spacecraft qualification.
2. Malfunction of failure investigation during spacecraft qualification.
3. Malfunction or failure investigation after launch.
4. Provide for experimenter change of requirements before and after launch.
5. Observation of unusual or unforseeable phenomenon.
6. Elimination of sampling of inputs associated with a failed experiment.
7. Temporary sampling of selected inputs.

A basic understanding of the VIP capabilities stated in this paper can enable users to obtain maximum benefit from the VIP's flexibility.

Acknowledgments

The design, development and breadboarding of the VIP concept was a result of a group effort. The group included Gene Czarcinski, John Lesko, Marvin Maxwell, and Joe Silverman. Special note is given to the contributions of Marvin Maxwell in the conceptual area, Gene Czarcinski in the detailing of the memory sequencer and reprogramming unit, Joe Silverman in the organization of the command list and John Lesko in the detailing of the gating.

FIGURES

Figure Number	Title
1	Nimbus D Versatile Information Processor
2	Nimbus D VIP 400 word/sec Sample Frame Format
2A	Nimbus D VIP Detailed 400 word/sec Sample Frame Format
3	Nimbus D VIP Digital "A" Interface
*A	VIP Memory Word
*B	VIP Sample Memory Program

*Appendix A Figures

APPENDIX A

*VIP COMMAND LIST DESCRIPTION

In the Versatile Information Processor subsystem, different internal commands will be used by the memory sequencer. These commands when executed in the proper sequence will be able to generate all of the types of programs or sequences required for the Nimbus D mission.

This appendix provides a detailed description of a set of commands which meet the VIP Specification requirements and describes how these commands can be used to generate the sample format Figure 2 and 2A.

I. Definitions:

1) "K" refers to any 10-bit word memory location, other than a scratch pad word location, where a specific command is stored.

2) "K+1", etc. refer to memory locations relative to a "K" location of a specific command.

3) "N" refers to any one of the eight scratch-pad 10-bit word memory locations. These eight locations are used as counters with the contents of one location, "N_o", assigned as the minor frame counter.

4) GATE/VALUE Tag refers to the memory sequencer output bit which specifies whether the 10-bit memory sequencer output is to be decoded by the formatting unit to select a particular data output (e.g., GATE) or whether the 10-bit output is to be inserted directly into the VIP output bit stream as sync, ID, etc. (e.g., VALUE).

5) "X" refers to 2 stored bits of information in the VIP which will be used to specify the starting addresses of four programs which can be stored in memory. When "X" equals the binary counts of zero, one, two, and three, the memory locations specified (addressed) will be eight, nine, ten and eleven respectively. The "X" storage bits will be controlled by four specific commands from the Nimbus Command Clock Subsystem.

6) "Y" refers to any one of a maximum of 120 arbitrary memory locations used for indirect addressing.

***The command list detailed herein is subject to modification for the final Nimbus D VIP configuration.**

II. Memory Word Description

A memory word location shall contain 10 bit positions (Figure A) with the most significant bit in position #10, next most significant bit in position #9, etc. (least significant bit in position #1).

If the four most significant bits (e.g. bits #10, #9, #8, #7) of a memory word location are not all binary "ones" (e.g. "1111"), the entire 10 bit word will be transferred to the memory sequencer output register (see "Command 0" of the following section).

If the four most significant bits of a memory word location are all binary "one's", the memory word will be used to generate "Command 1" through "Command 7" (these commands are described in the following section). For these commands, bits #6, #5, and #4 of the memory word location will be used to specify the command number with "001" specifying a "Command 1", "010" specifying a "Command 2", etc.; bits #3, #2, and #1 of the memory word location will be used to specify any counter ("N") used with a command, with "000" specifying "N_0", "001" specifying "N_1", etc.

III. Commands

At the initiation of each of the following commands, a different action is executed after first examining the contents of memory location "K".

After each command is executed, the memory sequencer output register will not be changed until a "go" signal from the formatting unit is received. The "go" signal indicates that the formatting unit has stored and used for a sampling period the output register contents and the memory sequencer can begin executing the next command; in this manner, the memory sequencer generates addresses and values to the formatting unit at the proper rate to meet the required system sampling rates.

Unless otherwise specified only one command is executed during a VIP sampling period.

A. Command 0

If "K" contains a "Command 0", transfer the contents of memory location "K" to the memory sequencer output register and set the output register GATE/VALUE Bit to GATE.

After a "Command 0" is executed, the next command shall be fetched from location "K+1".

A "Command 0" is used to generate sampling of arbitrary inputs one or more times in each minor frame.

B. Command 1

If "K" contains a "Command 1", transfer the contents of memory location "K+1" to the memory sequencer output register and set the output register GATE/VALUE tag to VALUE.

After a "Command 1" is executed, the next command shall be fetched from location "K+2".

A "Command 1" is used to generate synchronization, identification and other VALUE words.

C. Command 2

If "K" contains a "Command 2", transfer the contents of the specified scratch-pad memory location "N" to the memory sequencer output register, set the GATE/VALUE tag to GATE, and then increment the contents of "N" by the binary count of one.

After a "Command 2" is executed, the next command shall be fetched from location "K+1".

A "Command 2" is used with a "Command 3" to generate sequential subcommutation sequences (e.g. .....input 5, input 6, input 7, input 8.....). A "Command 3" must be used to specify the starting and limit values each sequential subcommutated sequence.

D. Command 3

If "K" contains a "Command 3", transfer the contents of the specified scratch-pad memory location "N" to the memory sequencer output register. If "N" specifies "N_o" (the minor frame counter), transfer the contents of "X" to the two most significant bit positions of the memory sequencer output register and set the GATE/VALUE tag to VALUE. (It is noted that "N_o" shall be limited to a maximum binary count of 255 (8 bits). Therefore, for "N"="N_o" only, 8 not 10 bits shall be transferred to the low order positions of the memory sequencer output register). If "N" specifies any counter other than "N_o" set the GATE/VALUE tag to GATE.

Next check "N_o" to determine if "N_o" equals the binary count of one. (This check is not made when the "N" specified by the "Command 3" in "K" is "N_o" since the purpose of the check is to make the other "N" counters synchronous with "N_o".) A count of one in "N_o" indicates that the minor frame being generated is the first minor frame of the major frame. If the contents of "N_o" equals the binary count of one, then load "N" with the contents of "K+2". If the contents of "N_o" does not equal one, proceed with the following test which is also performed when the "N" specified by the "Command 3" in "K" is "N_o".

Test the contents of "N" against the contents of "K+1". If the contents of "N" are less than the contents of "K+1", then increment the contents of "N" by a binary count of one. ("K+1" shall contain the limit value of the sequence.) If the contents of "N" are equal to or greater than the contents of "K+1", then load "N" with the contents of "K+2". ("K+2" shall contain the starting value of the sequence.)

After a "Command 3" is executed, the next command shall be fetched from location "K+3".

A "Command 3" is used with a "Command 2" to generate sequential subcommutation sequences. A "Command 3" must be used to specify the starting and limit values for each sequential subcommutated sequence. This command also generates the minor frame count and program mode identification word.

E. Command 4

If "K" contains a "Command 4", use the contents of the specified scratch-pad memory location "N" to select (indirectly address) a "Y" word to the memory sequencer output register, set the GATE/VALUE tag to GATE and increment the contents of "N" by one.

After a "Command 4" is executed, the next command shall be fetched from location "K+1".

A "Command 4" is used with a "Command 5" to generate arbitrary subcommutation sequences (e.g.,.....input 5, input 14, input 81, input 7.....). A "Command 5" must be used to specify the starting and limit "Y" addresses for each arbitraty subcommutated sequence.

F. Command 5

If "K" contains a "Command 5", use the contents of the specified scratch-pad memory location "N" to select (indirectly address) a "Y" memory location, and then transfer the contents of "Y" to the memory sequencer output register and set the GATE/VALUE tag to GATE. (It is noted that "N_o" would never be specified by a "Command 5".)

Next check "N_o" to determine if "N_o" equals the binary count of one. (The purpose of the check is to make the other "N" counters synchronous with "N_o".)

be a "Command 1" used to generate the minor frame sync word.) After this command in "K+1" is executed, do not proceed with the execution of another command until the VIP one per second synchronization pulse from the formatting unit is accepted by the memory sequencer.

If the contents of "N_O" does not equal the binary count of zero, execute the next command which shall be in location "K+1". The check of the VIP one per second synchronization pulse is not required when "N_O" does not equal binary count of zero.

It is noted that both the command following a "Command 7" and the "Command 7" are executed during a VIP sampling period.

After a "Command 7" is executed, the next command shall be fetched from location "K+1".

A "Command 7" is used to make the memory sequencer and the formatting unit timing synchronous with the Nimbus D Command Clock subsystem which generates the primary spacecraft clock frequencies and the Minitrack Time Code. If the memory sequencer and the formatting unit timing are synchronous with the Command Clock, the execution of a "Command 7" shall have no effect on the output program being generated by the memory sequencer; however, if the VIP is not in synchronism or loses synchronization with the Command Clock, execution of a "Command 7" by the memory sequencer shall "halt" generation of the memory sequencer program until synchronization is established.

IV. Memory Program

To illustrate the use of the preceding commands, a VIP memory program is shown in Figure B which will enable generation of the sample frame sequence shown in Figures 2 and 2A.

A count of one in "N_o" shall indicate that the minor frame being generated is the first minor frame of the major frame. If the contents of "N_o" equals the binary count of one, then load "N" with the contents of "K+2". If the contents of "N_o" does not equal the binary count of one, proceed with the following test:

Test the contents of "N" against the contents of "K+1". If the contents of "N" is less than the contents of "K+1", then increment the contents of "N" by a binary count of one. ("K+1" shall contain the limit address of the sequence.) If the contents of "N" is equal to or greater than the contents of "K+1", then load "N" with the contents of "K+2". ("K+2" shall contain the starting address of the sequence.)

After a "Command 5" is executed, the next command shall be fetched from location "K+3".

A "Command 5" is used with a "Command 4" to generate arbitrary subcommutation sequences. A "Command 5" must be used to specify the starting and limit addresses for each arbitrary subcommutated sequence.

G. Command 6

If "K" contains a "Command 6", examine the contents of "N_o". If the minor frame count indicates the last minor frame of the major frame (e.g. contents of "N_o" equals the binary count of zero), examine "X" and then load the instruction counter with the contents of the memory location specified (addressed) by "X". If the minor frame count does not equal the binary count of zero, load the instruction counter with the contents of "K+1" which shall specify the starting address of the program being executed.

It is noted that both the command following a "Command 6" and the "Command 6" are executed during a VIP sampling period.

After a "Command 6" is executed, the next command shall be fetched from the location specified by the instruction counter.

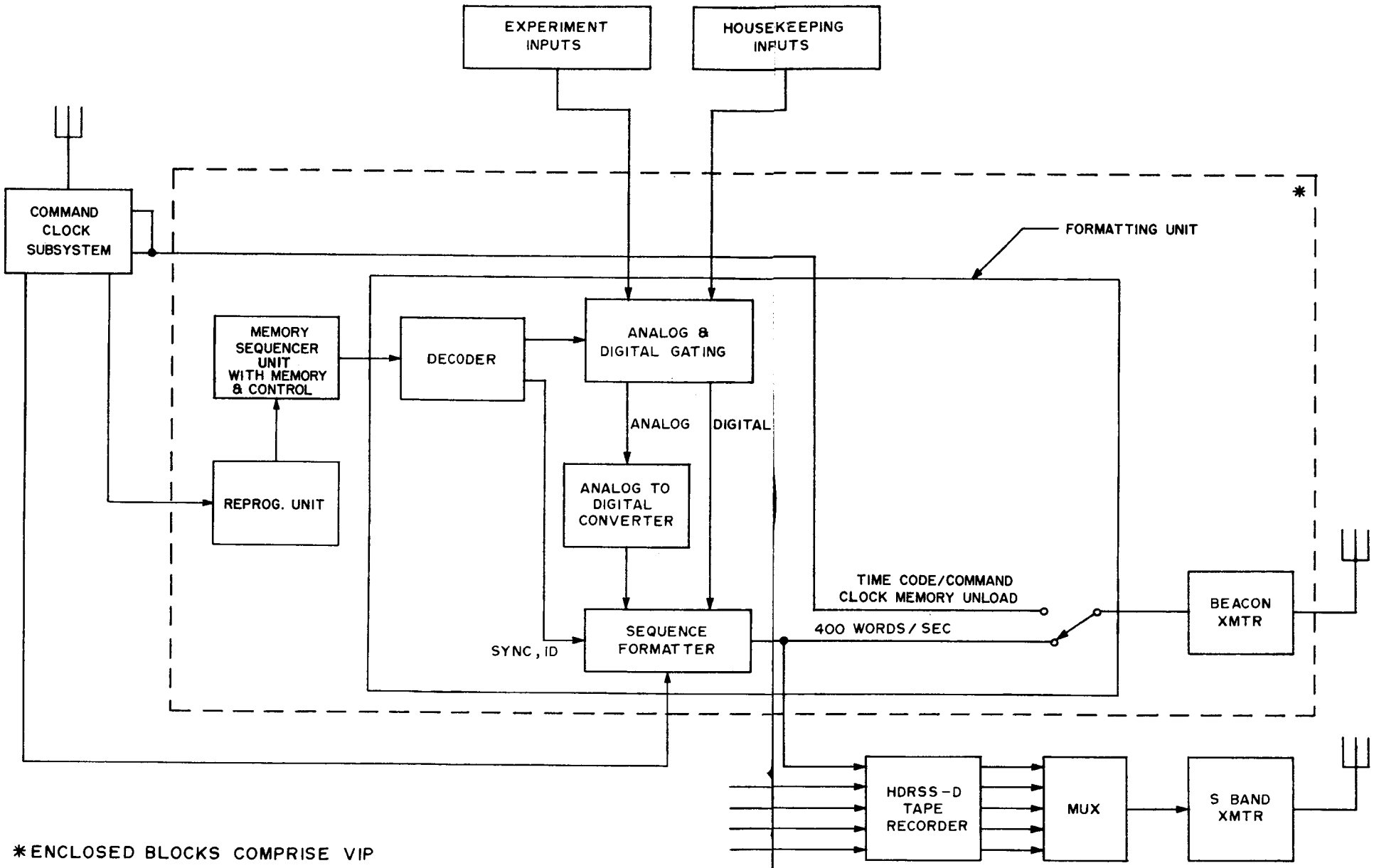
A "Command 6" is used to either jump back to the starting point of the program being generated or to jump to the starting point of a new program such that the new commutation sequence (program) always begins at the start of a major frame.

H. Command 7

If "K" contains a "Command 7", examine the contents of "N_o". If the contents of "N_o" equals the binary count of zero, execute the next command which shall be in location "K+1". (This command will normally

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A	REVISED WJS	9/29/66	PMF
B	REVISED	10/5/66	PMF

NIMBUS D VERSATILE INFORMATION PROCESSOR (VIP)



GC1183114 A

*ENCLOSED BLOCKS COMPRISE VIP

REQD	PART NO.	DESCRIPTION	MATL	MATL SPEC	UNIT WT

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±2°

NAME	INIT	DATE
DESIGNER		
DRAWN R.T. MILLS	RTM	6/29/66
CHECKED		
APPROVED P. FEINBERG	PMF	7/20/66
APPROVED		

NEXT ASSY | USED ON

FIGURE NUMBER 1
NIMBUS D
VERSATILE
INFORMATION PROCESSOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

GC 1183114

SCALE | UNIT WT | CODE 731.4 | SHEET 1 OF 1

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A	CORRECTIONS	8/8/66	

*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
	SYNC	SYNC	A_1	A_2	A_3	ID	D	A_1	A_2	A_3	C	B_1	A_1	A_2	A_3	Hh	F	A_1	A_2	A_3	Hh	C	A_1	A_2	A_3	HL	Hh	A_1	A_2	A_3	Hh	B_1	A_1	A_2	A_3	HL	B_2	A_1	A_2	A_3	Hh	C	A_1	A_2	A_3	HL	D	A_1	A_2	A_3	Hh	B_1	A_1	A_2	A_3	Hh	G	A_1	A_2	A_3	Hh	C	A_1	A_2	A_3	HL	E	A_1	A_2	A_3	J	B_1	A_1	A_2	A_3	HL	MT	A_1	A_2	A_3

400 WORDS/SECOND MINOR FRAME LENTH (80 WORDS)

0.2 SEC

KEY

A_1	CLOUD TOP SPECTROMETER	80 SAMPLES/SEC
A_2		80 SAMPLES/SEC
A_3		80 SAMPLES/SEC
B_1	FILTER WEDGE SPECTROM	20 SAMPLES/SEC
B_2		5 SAMPLES/SEC
C	TO BE DETERMINED	20 SAMPLES/SEC
D	INFRARED SPECTROM (SIRS)	10 SAMPLES/SEC
E	SELECTIVE CHOPPER RADIOMETER	5 SAMPLES/SEC
F	BACKSCATTER UV	5 SAMPLES/SEC
G	SFERICS	5 SAMPLES/SEC
HL, Hh	HOUSEKEEPING 400 CH	1/16 SAMPLE/SEC
	40 CH	1 SAMPLE/SEC
MT	MINITRACK TIME CODE	5 SAMPLES/SEC
SYNC	MINOR FRAME SYNC	
ID	MODE & MINOR FRAME IDENTIFICATION	
J	ULTRAVIOLET SPECTROM (MUSE)	5 SAMPLES/SEC

*EACH WORD CONTAINS 10 SERIAL BITS

MAJOR FRAME LENGTH: 80 MINOR FRAMES

SUB COMMUTATED CHS:

CH 16,21,27,31,41,51,56,61 DEPTH OF 5 [HIGH RATE 1 SAMPLE/SEC.] [Hh]

CH 26,36,46,66,76 (DEPTH OF 80) [LOW RATE 1 SAMPLE/16 SEC.] [HL]

GD 1183118

A

ITEM NO.	PART NO.	DESCRIPTION	MATL	MATL SPEC	UNIT WT.

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± 1/64 DECIMALS .005 ANGLES ± 2°

	NAME	INIT	DATE
DESIGNER			
DRAWN	R.T. MILLS	RTM	7/11/66
CHECKED			
APPROVED	P. FEINBERG	PF	7/11/66
APPROVED			

NEXT ASSY | USED ON

FIGURE NUMBER 2

NIMBUS D VIP

400 WORDS/SECOND

SAMPLE FRAME FORMAT

SCALE | UNIT WT

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

GD 1183118

CODE 731.4 | SHEET 1 OF 1

GRAMM'S FORMAT 08/C-6134, 8&M

1

2

"N" COUNTERS

MINOR FRAME WORD #

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
1	2	4	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
SYNC	SYNC	A_1	A_2	A_3	ID_0	D	A_1	A_2	A_3	C	B_1	A_1	A_2	A_3	H_1	F	A_1	A_2	A_3	H_1	C	A_1	A_2	A_3	H_1	H_1	A_1	A_2	A_3	H_1	H_1	A_1	A_2	A_3	H_1	B_2	A_1	A_2	A_3	H_1	C	A_1	A_2	A_3	H_1	D	A_1	A_2	A_3	H_1	B_1	A_1	A_2	A_3	H_1	G	A_1	A_2	A_3	H_1	C	A_1	A_2	A_3	H_1	E	A_1	A_2	A_3	H_1	J	A_1	A_2	A_3	H_1	MT	A_1	A_2	A_3
0																																																																																																									
*		1	2	3	-	4	1	2	3	5	48	1	2	3	46	500	1	2	3	32	5	1	2	3	450	33	1	2	3	120	48	1	2	3	131	47	1	2	3	101	5	1	2	3	132	4	1	2	3	102	48	1	2	3	103	10	1	2	3	81	5	1	2	3	133	64	1	2	3	55	48	1	2	3	582	1	2	3
1																																																																																																								
		1	2	3		4	1	2	3	5	48	1	2	3	34	500	1	2	3	35	5	1	2	3	134	36	1	2	3	104	48	1	2	3	135	47	1	2	3	105	5	1	2	3	136	4	1	2	3	106	48	1	2	3	107	10	1	2	3	15	5	1	2	3	137	64	1	2	3	55	48	1	2	3	583	1	2	3
2																																																																																																								
		1	2	3		4	1	2	3	5	48	1	2	3	37	500	1	2	3	38	5	1	2	3	138	39	1	2	3	108	48	1	2	3	139	47	1	2	3	108	5	1	2	3	140	4	1	2	3	110	48	1	2	3	111	10	1	2	3	391	5	1	2	3	141	64	1	2	3	55	48	1	2	3	584	1	2	3
3																																																																																																								
		1	2	3		4	1	2	3	5	48	1	2	3	40	500	1	2	3	41	5	1	2	3	142	42	1	2	3	112	48	1	2	3	143	47	1	2	3	113	5	1	2	3	144	4	1	2	3	114	48	1	2	3	115	10	1	2	3	639	5	1	2	3	145	64	1	2	3	55	48	1	2	3	585	1	2	3
4																																																																																																								
		1	2	3		4	1	2	3	5	48	1	2	3	43	500	1	2	3	44	5	1	2	3	146	45	1	2	3	116	48	1	2	3	147	47	1	2	3	117	5	1	2	3	148	4	1	2	3	118	48	1	2	3	119	10	1	2	3	9	5	1	2	3	149	64	1	2	3	55	48	1	2	3	606	1	2	3
5																																																																																																								
		1	2	3		4	1	2	3	5	48	1	2	3	46	500	1	2	3	32	5	1	2	3	150	33	1	2	3	120	48	1	2	3	151	47	1	2	3	101	5	1	2	3	152	4	1	2	3	102	48	1	2	3	103	10	1	2	3	81	5	1	2	3	153	64	1	2	3	55	48	1	2	3	607	1	2	3
78																																																																																																								
		1	2	3		4	1	2	3	5	48	1	2	3	40	500	1	2	3	41	5	1	2	3	442	42	1	2	3	112	48	1	2	3	443	47	1	2	3	113	5	1	2	3	444	4	1	2	3	114	48	1	2	3	115	10	1	2	3	639	5	1	2	3	445	64	1	2	3	55	48	1	2	3	580	1	2	3
79																																																																																																								
		1	2	3		4	1	2	3	5	48	1	2	3	43	500	1	2	3	44	5	1	2	3	446	45	1	2	3	116	48	1	2	3	447	47	1	2	3	117	5	1	2	3	448	4	1	2	3	118	48	1	2	3	119	10	1	2	3	9	5	1	2	3	449	64	1	2	3	55	48	1	2	3	581	1	2	3
0																																																																																																								
		1	2	3		4	1	2	3	5	48	1	2	3	46	500	1	2	3	32	5	1	2	3	450	33	1	2	3	120	48	1	2	3	131	47	1	2	3	101	5	1	2	3	132	4	1	2	3	102	48	1	2	3	103	10	1	2	3	81	5	1	2	3	133	64	1	2	3	55	48	1	2	3	582	1	2	3

* EACH NUMBER WHICH APPEARS AT THE BOTTOM OF MINOR FRAME WORDS INDICATES THE SPECIFIC GATE ADDRESSED BY THE MINOR FRAME WORD.

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL

GE 1183 141

REQD	PART NO.	DESCRIPTION	MATL	MATL SPEC	UNIT WT
		LIST OF MATERIAL			

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 30'

	NAME	INIT	DATE
DESIGNED			
DRN WITH	W. K. WHYTE	WKW	9-20-66
CHECKED			
APPROVED			
APPROVED			

NIMBUS D VIP
DETAILED SAMPLE
FRAME FORMAT
FIG 2A

NEXT ASSY | USED ON

SCALE | UNIT WT

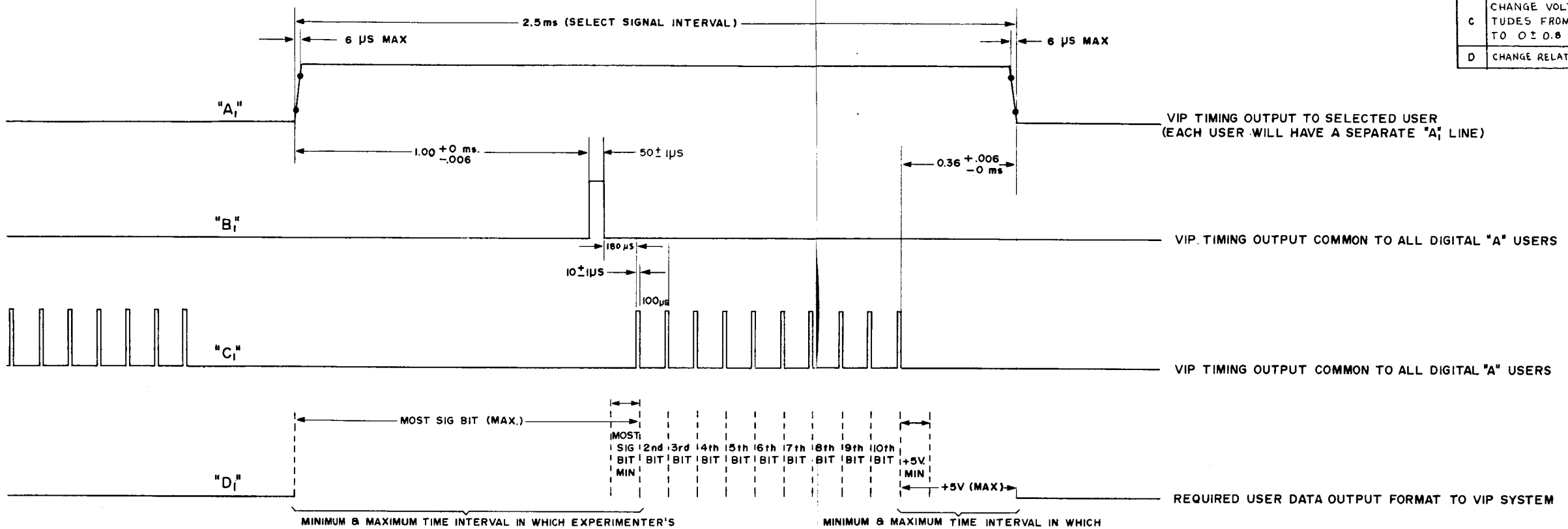
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

GE 1183141

CODE | SHEET OF

1 2

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A	CHANGE Zo OF "B_1" AND "C_1"	3/31	PMF
B	CHANGE Zo OF "A_1", "B_1" & "C_1"	4/6/66	PMF
C	CHANGE VOLTAGE OF AMPLITUDES FROM 0 ± 0.6 VOLTS TO 0 ± 0.8 VOLTS	7/11/66	PMF
D	CHANGE RELATIVE TIMING	8/19/66	PMF



REQUIRED OUTPUT CHARACTERISTICS

"A_1": AMPLITUDE 0 ±0.8 VOLTS OR +5 ±0.8 VOLTS, Zo = 5,000 ohms OR LESS

"B_1": AMPLITUDE 0 ±0.8 VOLTS OR +5 ±0.8 VOLTS, Zo = 600 ohms OR LESS, RISE & FALL TIME LESS THAN 1μS
[USER LOAD IMPEDANCE: 20,000 ohms MIN.; CAPACITIVE LOAD 25 pf MAX.; TRANSFORMER COUPLING RECOMMENDED]

"C_1": AMPLITUDE 0 ±0.8 VOLTS OR +5 ±0.8 VOLTS, Zo = 600 ohms OR LESS, RISE & FALL TIME LESS THAN 1μS
[USER LOAD IMPEDANCE: 20,000 ohms MIN.; CAPACITIVE LOAD 25 pf MAX.; TRANSFORMER COUPLING RECOMMENDED]

"D_1": AMPLITUDE 0 ±0.8 VOLTS FOR LOGICAL "0" AND +5 ±0.8 VOLTS FOR LOGICAL "1", RISE & FALL TIME LESS THAN 1μS. WITH EXPERIMENT POWER ON OR OFF, USERS "D_1" SOURCE IMPEDANCE SHALL BE 600 ohms OR LESS
[VIP LOAD IMPEDANCE: 5000 ohms MIN]

GD 1183072
D

REQD	PART NO	DESCRIPTION	MATL	MATL SPEC	UNIT WT

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 2°

NAME	INIT	DATE
DESIGNER		
DRAWN R. MILLS	RTM	3/21/66
CHECKED		
APPROVED P. FEINBERG	PMF	3/21/66
APPROVED		

NEXT ASSY | USED ON

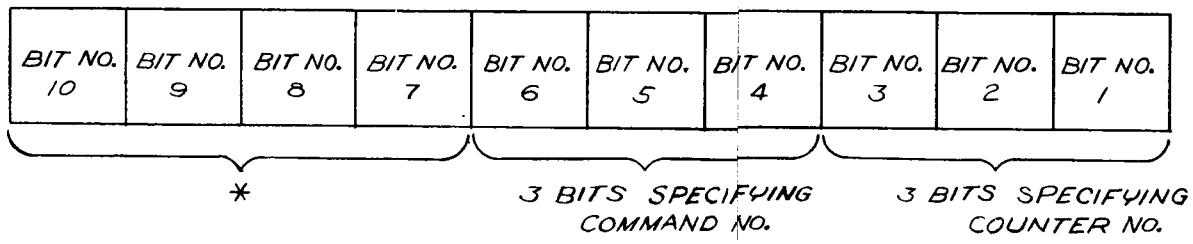
FIGURE NUMBER 3
NIMBUS D VIP
DIGITAL "A" INTERFACE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

GD 1183072 D

SCALE | UNIT WT | CODE 731.4 | SHEET 1 OF 1

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL



BIT NO. 10	BIT NO. 9	BIT NO. 8	BIT NO. 7	BIT NO. 6	BIT NO. 5	BIT NO. 4	BIT NO. 3	BIT NO. 2	BIT NO. 1
*				3 BITS SPECIFYING COMMAND NO.			3 BITS SPECIFYING COUNTER NO.		

GC 1183271

* IF 4 BITS ARE ALL "1'S", MEMORY WORD USED TO GENERATE COMMAND 1 THRU 7. IF 4 BITS ARE NOT ALL "1'S", 10 BIT MEMORY WORD OUTPUT AS A "GATE".

REQD	PART NO.	DESCRIPTION	MATL	MATL SPEC	UNIT WT.

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±2°

NAME	INIT	DATE
DESIGNER		
DRAWN SMITH	[illegible]	3-10-67
CHECKED		
APPROVED P. Feinberg	[illegible]	3/67
APPROVED		

NEXT ASSY | USED ON

FIG. A
VIP MEMORY WORD

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

GC 1183271

SCALE | UNIT WT | CODE 731 | SHEET 1 OF 1

DRAWING FORMAT 66FC-6-10A (8X8)

MEMORY LOCATION #	CONTENTS OF MEMORY LOCATION BIT # 10 9 8 7 6 5 4 3 2 1	VIP COMMAND #	"N" COUNTER USED	INPUT SPECIFIED	MINOR FRAME WORD #	REMARKS
0	← CONTENTS OF "N_0" →	-	-	-	-	MINOR FRAME COUNTER
1	← CONTENTS OF "N_1" →	-	-	-	-	
2	← CONTENTS OF "N_2" →	-	-	-	-	
3	← CONTENTS OF "N_3" →	-	-	-	-	
4	← CONTENTS OF "N_4" →	-	-	-	-	
5	← CONTENTS OF "N_5" →	-	-	-	-	
6	← CONTENTS OF "N_6" →	-	-	-	-	
7	← CONTENTS OF "N_7" →	-	-	-	-	
8	0 0 0 0 0 0 1 1 0 0	-	-	-	-	STARTING ADDRESS OF THIS PROGRAM (MEMORY LOCATION #12)
9	← START. ADD. OF PROG. # 2 →	-	-	-	-	
10	← START. ADD. OF PROG. # 3 →	-	-	-	-	
11	← START. ADD. OF PROG. # 4 →	-	-	-	-	
12	0 0 0 0 0 0 0 0 1 1	0	-	A_3	80	SAMPLE A_3 USING GATE #3
13	1 1 1 1 1 1 1 - - -	7	-	-	-	
14	1 1 1 1 0 0 1 - - -	1	-	-	1	OUTPUT FOLLOWING WORD AS FRAME SYNC. PATTERN
15	——— SYNC ——— →	-	-	-	-	FRAME SYNC
16	1 1 1 1 0 0 1 - - -	1	-	-	2	
17	——— SYNC ——— →	-	-	-	-	
18	0 0 0 0 0 0 0 0 0 1	0	-	A_1	3	SAMPLE A_1 USING GATE # 1
19	0 0 0 0 0 0 0 0 1 0	0	-	A_2	4	SAMPLE A_2 USING GATE # 2
20	0 0 0 0 0 0 0 0 1 1	0	-	A_3	5	
21	1 1 1 1 0 1 1 0 0 0	3	0	-	6	GENERATE MINOR FRAME COUNT AND PROGRAM ID
22	- - 0 1 0 0 1 1 1 1	-	-	-	-	MINOR FRAME CT. LIMIT VALUE (79)
23	- - 0 0 0 0 0 0 0 0	3	-	-	6	MINOR FRAME CT. STARTING VALUE (0)
24	0 0 0 0 0 0 0 1 0 0	0	-	D	7	SAMPLE D USING GATE #4
25	0 0 0 0 0 0 0 0 0 1	0	-	A_1	8	
26	0 0 0 0 0 0 0 0 1 0	0	-	A_2	9	
27	0 0 0 0 0 0 0 0 1 1	0	-	A_3	10	
28	0 0 0 0 0 0 0 1 0 1	0	-	C	11	SAMPLE C USING GATE # 5
29	0 0 0 0 1 1 0 0 0 0	0	-	B_1	12	SAMPLE B, USING GATE # 48
30	0 0 0 0 0 0 0 0 0 1	0	-	A_1	13	
31	0 0 0 0 0 0 0 0 1 0	0	-	A_2	14	
32	0 0 0 0 0 0 0 0 1 1	0	-	A_3	15	
33	1 1 1 1 0 1 1 0 0 1	3	1	H_h	16	COUNTER 1 SPECIFIES GATES #34, #37, #40, #43, AND #46
34	0 0 0 0 1 0 1 1 1 0	-	-	-	-	COUNTER 1 LIMIT VALUE (46)
35	0 0 0 0 1 0 0 0 0 0	-	-	-	-	COUNTER 1 STARTING VALUE (32)
36	0 1 1 1 1 1 0 1 0 0	0	-	F	17	SAMPLE F USING GATE # 500
37	0 0 0 0 0 0 0 0 0 1	0	-	A_1	18	
38	0 0 0 0 0 0 0 0 1 0	0	-	A_2	19	
39	0 0 0 0 0 0 0 0 1 1	0	-	A_3	20	
40	1 1 1 1 0 1 0 0 0 1	2	1	H_h	21	COUNTER 1 SPECIFIES GATES #32, #35, #38, #41, AND #44
41	0 0 0 0 0 0 0 1 0 1	0	-	C	22	
42	0 0 0 0 0 0 0 0 0 1	0	-	A_1	23	
43	0 0 0 0 0 0 0 0 1 0	0	-	A_2	24	
44	0 0 0 0 0 0 0 0 1 1	0	-	A_3	25	
45	1 1 1 1 0 1 1 1 0 0	3	4	H_L	26	COUNTER 4 SPECIFIES GATES #134, #138, #142, #146, ... #450
46	0 1 1 1 0 0 0 0 1 0	-	-	-	-	COUNTER 4 LIMIT VALUE (450)
47	0 0 1 0 0 0 0 0 1 1	-	-	-	-	COUNTER 4 STARTING VALUE (131)
48	1 1 1 1 0 1 0 0 0 1	2	1	H_h	27	COUNTER 1 SPECIFIES GATES #33, #36, #39, #42, AND #45
49	0 0 0 0 0 0 0 0 0 1	0	-	A_1	28	
50	0 0 0 0 0 0 0 0 1 0	0	-	A_2	29	
51	0 0 0 0 0 0 0 0 1 1	0	-	A_3	30	
52	1 1 1 1 0 1 1 0 1 0	3	2	H_h	31	COUNTER 2 SPECIFIES GATES #104, #108, #112, #116, AND #120
53	0 0 0 1 1 1 1 0 0 0	-	-	-	-	COUNTER 2 LIMIT VALUE (120)
54	0 0 0 1 1 0 0 1 0 1	-	-	-	-	COUNTER 2 STARTING VALUE (101)
55	0 0 0 0 1 0 1 1 1 0	0	-	B_1	32	
56	0 0 0 0 0 0 0 0 0 1	0	-	A_1	33	
57	0 0 0 0 0 0 0 0 1 0	0	-	A_2	34	
58	0 0 0 0 0 0 0 0 1 1	0	-	A_3	35	
59	1 1 1 1 0 1 0 1 0 0	2	4	H_L	36	COUNTER 4 SPECIFIES GATES #131, #135, #139, ... #448
60	0 0 0 0 1 0 1 1 1 1	0	-	B_2	37	SAMPLE B_2 USING #47

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL

GC 1183 150

REQD	PART NO.	DESCRIPTION	MATL	MATL SPEC	UNIT WT.

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED	NAME	INIT	DATE
DIMENSIONS ARE IN INCHES	DESIGNER		
TOLERANCES ON: FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±.2°	DRAWN R. K. Whyte	RKW	10/5/66
	CHECKED		
	APPROVED P. Feinberg	PMB	10/5/66
NEXT ASSY / USED ON	APPROVED		

FIG. B
VIP SAMPLE MEMORY PROGRAM

SCALE | UNIT WT

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

G 1183 150A

CODE | SHEET 1 OF 2

MEMORY LOCATION	CONTENTS OF MEMORY LOCATION BIT# 10 9 8 7 6 5 4 3 2 1	VIP COMMAND #	"N" COUNTER USED	INPUT SPECIFIED	MINOR FRAME #	REMARKS
61	0 0 0 0 0 0 0 0 0 1	0	-	A_1	38	
62	0 0 0 0 0 0 0 0 1 0	0	-	A_2	39	
63	0 0 0 0 0 0 0 0 1 1	0	-	A_3	40	
64	1 1 1 1 0 1 0 0 1 0	2	2	Hn	41	
65	0 0 0 0 0 0 0 1 0 1	0	-	C	42	
66	0 0 0 0 0 0 0 0 0 1	0	-	A_1	43	
67	0 0 0 0 0 0 0 0 1 0	0	-	A_2	44	
68	0 0 0 0 0 0 0 0 1 1	0	-	A_3	45	
69	1 1 1 1 0 1 0 1 0 0	2	4	H_L	46	
70	0 0 0 0 0 0 0 0 1 0	0	-	D	47	
71	0 0 0 0 0 0 0 0 0 1	0	-	A_1	48	
72	0 0 0 0 0 0 0 0 1 0	0	-	A_2	49	
73	0 0 0 0 0 0 0 0 1 1	0	-	A_3	50	
74	1 1 1 1 0 1 0 0 1 0	2	2	Hn	51	
75	0 0 0 0 1 1 0 0 0 0	0	-	B_1	52	
76	0 0 0 0 0 0 0 0 0 1	0	-	A_1	53	
77	0 0 0 0 0 0 0 0 1 0	0	-	A_2	52	
78	0 0 0 0 0 0 0 0 1 1	0	-	A_3	53	
79	1 1 1 1 0 1 0 0 1 0	2	2	Hn	56	
80	0 0 0 0 0 0 1 0 1 0	0	-	G	57	SAMPLE G USING GATE #10
81	0 0 0 0 0 0 0 0 0 1	0	-	A_1	58	
82	0 0 0 0 0 0 0 0 1 0	0	-	A_2	59	
83	0 0 0 0 0 0 0 0 1 1	0	-	A_3	60	
84	1 1 1 1 1 0 1 0 1 1	5	3	Hn	61	COUNTER 3 USED IN SPECIFYING GATES #15,#591,#639,#9, AND #81
85	0 0 0 1 1 1 0 0 0 1	-	-	-	-	LIMIT ADDRESS (113)
86	0 0 0 1 1 0 1 1 0 1	-	-	-	-	STARTING ADDRESS (109)
87	0 0 0 0 0 0 0 1 0 1	0	-	C	62	
88	0 0 0 0 0 0 0 0 0 1	0	-	A_1	63	
89	0 0 0 0 0 0 0 0 1 0	0	-	A_2	64	
90	0 0 0 0 0 0 0 0 1 1	0	-	A_3	65	
91	1 1 1 1 0 1 0 1 0 0	2	4	H_L	66	
92	0 0 0 1 0 0 0 0 0 0	0	-	E	67	SAMPLE E USING GATE #64
93	0 0 0 0 0 0 0 0 0 1	0	-	A_1	68	
94	0 0 0 0 0 0 0 0 1 0	0	-	A_2	69	
95	0 0 0 0 0 0 0 0 1 1	0	-	A_3	70	
96	0 0 0 0 1 1 0 1 1 1	0	-	J	71	SAMPLE J USING GATE #55
97	0 0 0 0 1 1 0 0 0 0	0	-	B_1	72	
98	0 0 0 0 0 0 0 0 0 1	0	-	A_1	73	
99	0 0 0 0 0 0 0 0 1 0	0	-	A_2	74	
100	0 0 0 0 0 0 0 0 1 1	0	-	A_3	75	
101	1 1 1 1 0 1 1 1 0 1	3	5	H_L	76	COUNTER 5 SPECIFIES GATES #503,#504,#505,.....#582
102	1 0 0 1 0 0 0 1 1 0	-	-	-	-	COUNTER 5 LIMIT VALUE (582)
103	0 1 1 1 1 1 0 1 1 1	-	-	-	-	COUNTER 5 STARTING VALUE (503)
104	0 0 0 0 0 0 0 0 0 0	0	-	MT	77	TRANSFER CONTENTS OF TIME CODE FORMATTER TO 400 WORD/SEC FORMATTER
105	0 0 0 0 0 0 0 0 0 1	0	-	A_1	78	
106	0 0 0 0 0 0 0 0 1 0	0	-	A_2	79	
107	1 1 1 1 1 1 0 - - -	6	-	-	-	"JUMP" COMMAND
108	0 0 0 0 0 0 1 1 0 0	-	-	-	-	STARTING ADDRESS OF THIS PROGRAM
109	0 0 0 0 0 0 1 1 1 1	-	-	-	-	"Y" MEMORY LOCATION SPECIFIES GATE #15
110	1 0 0 1 0 0 1 1 1 1	-	-	-	-	"Y" MEMORY LOCATION SPECIFIES GATE #591
111	1 0 0 1 1 1 1 1 1 1	-	-	-	-	"Y" MEMORY LOCATION SPECIFIES GATE #639
112	0 0 0 0 0 0 1 0 0 1	-	-	-	-	"Y" MEMORY LOCATION SPECIFIES GATE #9
113	0 0 0 1 0 1 0 0 0 1	-	-	-	-	"Y" MEMORY LOCATION SPECIFIES GATE #81

REVISIONS

SYM	DESCRIPTION	DATE	APPROVAL

GC1183 150

REQD	PART NO.	DESCRIPTION	MATL	MATL SPEC	UNIT WT.

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±.2°

	NAME	INIT	DATE
DESIGNER			
DRAWN	H. K. Whyte	HKW	10/5/66
CHECKED			
APPROVED	P. Feinberg	PF	10/5/66
APPROVED			

NEXT ASSY | USED ON

FIG 8 (CONT)
VIP SAMPLE MEMORY PROGRAM

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

G 1183 150B

SCALE | UNIT WT | CODE | SHEET 2 OF 2